INTRODUCTION

Background

The importation of irrigation water to the arid San Joaquin Valley through the construction of the Central Valley Project and State Water Project has allowed for the growth of a large and economically prosperous agricultural industry. However, drainage problems plague many west-side farmers due to high levels of groundwater and saline oils. Marine-derived soil constituents such as selenium, molybdenum, boron, and others often reach toxic levels in drainwater creating potential hazards to wildlife and human health (SJVDP 1990).

The presence of high groundwater beneath west-side fields is related to the geologic history of the Valley and large volumes of imported irrigation water. An expansive clay layer, known as the Corcoran Clay, was formed approximately 600,000 years ago when the Valley was covered with a shallow ocean. The clay layer ranges from 20 to 200 feet in thickness and retards the downward flow of water. The presence of this impermeable layer has created a semi-confined aquifer above it, and a confined aquifer below (SJVDP 1990). Decades of irrigation have leached salts and trace elements into upper regions of the semi-confined aquifer creating shallow, contaminated groundwater.

Many areas on the west-side have groundwater 5 feet or less beneath the soil surface (SJVDP 1990). These same fields are also naturally high in salts, and receive imported irrigation water each year which also contains salts. A common practice used to leach out the salts to increase productivity is pre-irrigation, or using water to flush out salts prior to cultivating a crop. To prevent the groundwater from rising further and saturating the crop root zone, tile-drainage systems have been installed which collect the pre-irrigation water and remove it for disposal elsewhere (SJVDP 1990).

The agricultural drainwater produced as a result of pre-irrigation often contains hazardous levels of trace elements which have been shown to produce significant toxic effects in breeding shorebirds at Kesterson Reservoir and other sites (Hoffman et al. 1988, Lemly, 1994, Ohlendorf et al. 1986*a*, Ohlendorf et al. 1986*b*, Ohlendorf et al. 1987, Ohlendorf 1989, Skorupa 1998, Zahm 1986). Observed effects of selenium exposure included emaciation, lesions and liver damage in adult birds, and congenital malformations in embryos such as missing or abnormal eyes and beaks (Ohlendorf et al. 1988b). Safe disposal of agricultural drainwater is an ongoing challenge for farmers on west-side fields in the San Joaquin Valley.

Land Retirement Program

The San Joaquin Valley Drainage Program Final Report recommended the selective retirement of irrigated lands as an option for decreasing the volume of selenium-contaminated drainage water. Specifically, agricultural lands characterized by low productivity, poor drainage, and high selenium were targeted in the proposed management plan (SJVDP 1990).

On 30 October 1992, Congress enacted Public Law 102-575, known as the Central Valley Project Improvement Act (CVPIA). Section 3408(h), Title XXXIV of Public Law 102-575 authorized a federal land retirement program. A multi-agency team, which includes representatives from the Bureau of Reclamation (USBR), United States Fish and Wildlife Service (FWS) and the Bureau of Land Management (BLM), was assembled to accomplish the objectives of the land retirement program.

The objectives of the land retirement program are to:

1) Reduce drainage volume,
2) Acquire water for CVPIA improvements, and
3) Enhance fish and wildlife resources.

Decreased irrigation of the poorest quality west-side lands should lead to a reduction in volume of subsurface drainage water produced and an overall decrease in the concentration of salts and trace elements in the remaining drainwater. The effect would be decreased exposure of wildlife to toxic levels of those elements. Water acquired along with land purchases will be used to enhance water supplies for CVPIA projects. Possible uses for acquired water include restoration of retired land to native habitat and enhancement of wildlife refuge or anadromous fish water supplies. Fish and wildlife resource enhancement can be achieved through active restoration of retired lands to native communities, or through reallocation of water to existing resources.

According to the Interim Land Retirement Program Guidelines, lands eligible for retirement from irrigated agriculture must receive CVP water and meet criteria regarding groundwater depth and selenium levels (USDI 1997). Lands are purchased solely on a willing-seller basis. The Interagency Land Retirement Team (LRT) accepts proposals from landowners wishing to sell and considers a number of criteria in selecting parcels for retirement.

The general criteria used to select lands for retirement include:

- High selenium concentrations in the groundwater,
- Shallow groundwater (< 10 feet),
- Poor drainage and low productivity,
- Potential for re-establishment of native upland habitat,
- Connectivity with other natural areas, and
- Availability of large blocks of land, or occurrence within a specified wildlife movement corridor (USFWS 1998).

Land Retirement Demonstration Project

A land retirement demonstration project has been initiated by the LRT in cooperation with the Endangered Species Recovery Program (ESRP). The project is designed to determine the effectiveness of different techniques in restoring native habitat and to monitor for potential contamination to wildlife resulting from the high selenium levels in shallow groundwater. The project will provide a way to test various habitat restoration and management strategies on a relatively small scale prior to implementation of land retirement on tens of thousands of acres.

Two primary concerns of the LRT are:

- unmanaged would be a potential source of weeds and pests to neighboring farms, and
- return to upland without a restoration effort of some kind would take 10-20 years or more.

One reason for the long time-frame would be the lack of native upland vegetation remaining to serve as a seed source for the retired land. Isolation of the remaining pieces also could hinder wide range dispersal. This time frame may be compressed by active restoration of retired parcels so that desired native plant species become established and have advantage over non-natives and pests within a few years of purchase.

Demonstration Project Location and Site Description

The Demonstration Project was initiated on 1600 acres purchased by the LRT within the last two years. The project site is about 1 mile southwest of the Mendota Wildlife Area in western Fresno county at T 15S, R 15E, Sec. 10, 15, 16, 23, and 27 (Figure 1). As further land acquisitons take place, the Demonstration Project will expand from its current size to approximately 15,000 acres and will include a comparison site in the E. Kings and W. Tulare County area.

A majority of the Demonstration Projects was under recent cultivation, although the most of Section 10 has not been farmed in over five years. In 1995, about 140 acres in Section 10 were used for an unsuccessful barley crop, and in 1996 and 1997 approximately 60 acres were planted in safflower to support a spring dove hunt sponsored by the Department of Fish and Game (DFG) Upland Gamebird Heritage Program (D. Bowman pers. comm). Cotton, sugar beets, and alfalfa were the major crops produced on the remainder of the demonstration site.

Soils on demonstration project lands are comprised mostly of the Tranquility series, with a small amount of Lillis and Lethent series in the northern ½ of Sec. 10 (Figure 2). They are characterized as very deep, moderately well-drained, saline sodic soils. These soils are suitable for wildlife habitat or irrigation of salt-tolerant crops. Intensive management is generally required to reduce salinity in the crop root zone and maintain productivity (USDA in press). Soil selenium is estimated to be approximately 1 ppm in this area (SJVDP 1990).

Measurements of groundwater depth taken at the site indicate that the beneath demonstration project lands ranges from 5 to 15 feet below the soil surface. Selenium concentrations in the groundwater range from 50 to over 200 mg/l (ppb) (SJVDP 1990). These concentrations are considered to be very high and exceed the EPA ambient water quality criteria for selenium, which is 5 ppb for chronic toxicity and 20 ppb for acute toxicity (USEPA 1987).

A baseline biological inventory was conducted by ESRP biologists in December 1998 to document plant and animal species on the demonstration site prior to planting the cover crop (Tables 1 and 2, Appendix A). As such, fields are leveled and vegetation is sparse and limited mostly to non-native weedy plant species inhabiting field edges. Surveys consisted of drive-through and walk-over surveys; the intensity of surveys for each parcel was based on its current condition. Recently cultivated fields were walked at the edges to generate a plant list and look for animal sign. Idled fields with dense vegetation were examined more closely (Appendix A).

Some bird and mammal species use the property in its current state (Tables 1 and 2). Higher numbers of plant and animal species were observed on fields which had been fallow for more than one year. Section 10, which has been out of cultivation for the longest time, had the highest species richness and abundance of plants and animals.

The mountain plover (*Charadrius montanus*), a federal Candidate and California Species of Concern was the one sensitive species found at the site. A small flock of approximately 15 birds was observed on the eastern edge of the southeast ¼ of the southwest ¼ of Section10, during a post-planting follow-up visit to the site. Other state Species of Concern observed on the site were the horned lark, loggerhead shrike, northern harrier, short-eared owl, burrowing owl, and the white-tailed kite. No sensitive plant species were observed.

Demonstration Project Goals

The land retirement demonstration project was initiated to address concerns about the scope and degree of impacts of retirement on wildlife, drainage volume reduction, socio-economics, and overall cumulative effects of removal of land from irrigated agriculture. Results from monitoring the demonstration project will be used to prepare environmental analysis for further land retirement and guide restoration decisions on additional retired lands.

The Demonstration Project objectives are to use adaptive management (Holling 1978, Walters and Holling 1990) and monitor a 15,000-acre Demonstration Project to develop cost-effective upland habitat restoration techniques for use on larger areas of retired agricultural lands. This will be accomplished through examination of impacts from land retirement on biota and physical changes in soil and groundwater chemistry and groundwater depth: and education of stakeholders about the land retirement program.

Demonstration Project Objectives

The desired outcome for these retired agricutlural lands is for drainage improvement and the reestablishment of self-sustaing upland communities, mostly a mix of native California prairie and San Joaquin saltbush communities. Since relative little information is available about upland community restoration in arid regions, the Demonstration Project will provide a study of various rehabilitation techniques prior to implementation on a larger scale. An important aspect of the success of land retirement is the recolonization of retired lands by native plants and animals. Monitoring of the biotic response to the habitat restoration experiment will allow for examination of the impacts of various types of habitat manipulation on plants and wildlfie. Adaptive management strategies for long-term management of retired lands will use the data from this study as results form the specific objectives of the habitat restoration study are met. These objectives are:

- Determine the efficacy of revegetation with native plants as a means to facilitate upland habitat restoration,
- Determine the efficacy of microtopographic contouring as a means to facilitate upland habitat restoration, and
- Examine the effects of phased reintroductions of small mammals

Specifically, the objectives of the demonstration project are:

- Use adaptive management (Holling 1978, Walters and Holling 1990) and monitoring of a 15,000-acre demonstration project to develop cost-effective upland habitat restoration techniques for use on larger areas of retired agricultural land. This will be accomplished through:

    a) Examination of impacts to biota from land retirement, and
    b) Examination of the physical impacts of land retirement, such as changes in soil and ground water chemistry and ground water depth and,

- Educate stakeholders about the land retirement program.

A contaminants monitoring plan has been developed, in cooperation with USFWS, which outlines a sampling regime appropriate for identifying negative impacts from contaminants potentially occurring on retired lands (Appendix B). The soil and ground water beneath all retired lands require monitoring to document the changes that occur due to removal of the land from cultivation, and to ensure that wildlife is not affected negatively by the presence of selenium or other contaminants. Although the ground water depth beneath retired lands

is expected to drop due to cessation of irrigation (SJVDP 1990), there is the possibility of ground water rising to the surface, which would create toxicity concerns (Poister and Tokunaga 1992, Tokunaga and Benson 1992). The interaction of selenium-contaminated ground water with saline surface soils also containing selenium could lead to a toxic situation for wildlife, as has been observed in Kesterson Reservoir rainwater pools (Zawislanski et al. 1992). Monitoring of soil and ground water changes will allow for quick action if a contamination hazard is identified.